Venous Thromboembolism after Arthroscopic Rotator Cuff Repair in a Patient with a Negative Pre-Surgical SARS-CoV-2 Test that Developed Symptomatic COVID-19 Three Days after Surgery

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INTRODUCTION:

The rate of venous thromboembolism (VTE) after elective shoulder arthroscopy cases is rare and there also has not been substantial evidence to support the use of routine post-operative anti-coagulation.[1,6,8,9] However, with the recent pandemic of the SARS-CoV-2 virus that causes COVID-19 infections, there has been significant concern over the high rate of VTE observed in infected patients.[3,5,7] The virus seems to stimulate a strong micro-vascular endothelial cell response that leads to thrombosis and clot formation.[7] As we resume normal elective surgery, we have nation-wide implemented routine pre-procedural viral screening. However, as our testing has improved, it is still far from perfect. Anecdotally in our practice, we have had numerous asymptomatic patients who test positive for the virus in their routine pre-procedure screening that are either latent infections or false positives. However, the real concern occurs when patients who test negative, have surgery, but are actually infected and become symptomatic soon thereafter.

In this case report, we discuss the rare occurrence of a post-operative upper extremity deep venous thrombosis (DVT) and pulmonary embolus (PE) that formed acutely after an elective, outpatient arthroscopic rotator cuff repair in an otherwise healthy, young patient. The patient tested negative for the SARS-CoV-2 virus on her pre-operative screening, indicating no active COVID-19 infection. However, the patient became symptomatic 3 days after surgery and was found to have a positive exposure the day before surgery which led to her infection. We believe, the risk factors of surgery combined with her unknown COVID-19 infection created a significant pro-thrombotic state that led her to have this rare VTE event.

CASE REPORT:

A 42-year-old right-hand dominant woman, with no significant past medical history, suffered a left shoulder injury after a fall eight months prior to presentation. She failed conservative treatment with physical therapy, and magnetic resonance imaging (MRI) was obtained by her primary care physician. She was then sent to orthopedic surgery for evaluation and treatment. Her left shoulder exam demonstrated 90 degrees of painful standing forward flexion, passive forward flexion to 150 degrees, active external rotation of 80 degrees, and active internal rotation to L1. She had 3/5 supraspinatus strength, but the remainder of the rotator cuff tendons had 5/5 strength. She had significant pain of the proximal biceps tendon and positive Jobe, O'Briens, and impingement testing. Radiographs of the left shoulder showed no acute or chronic abnormalities. The left shoulder MRI showed a high grade (~80%), articular sided partial thickness supraspinatus tear with retraction of the torn fibers **(Figure 1)** and proximal biceps tendon inflammation with an associated superior labrum anterior to posterior (SLAP) tear. She was indicated for surgery given her failed conservative treatment, age, activity level, diminished shoulder function, and severity of the rotator cuff tear on MRI. The patients' preoperative reported outcomes were a VAS score of 5, ASES Shoulder Score of 6/30, shoulder score index of 35/100, and simple shoulder test of 2/12.

The patient underwent routine arthroscopic management of her shoulder under an interscalene regional block. Given the high grade of the articular side of the tear, the bursal side of the tendon was taken down to complete the tear to perform a full repair. A trans-osseous equivalent, double-row repair with a medial row double pulley was performed as previously described **(Figure 2).**[2] Based on her pre-operative clinical and imaging findings, a subacromial

decompression and an arthroscopic suprapectoral biceps tenodesis was also performed as described.[4] The operative time was recorded as 65 minutes for this case.

At our institution, a pre-procedure SARS-CoV-2 viral PCR test is administered 48-72 hours prior to all elective surgeries. The patient's test was negative three days prior to surgery. However, unknown to the patient, she had a positive exposure with an infected individual he day before her scheduled surgery. She became symptomatic 3 days after surgery with a confirmed positive SARS-CoV-2 test. She was initially treated with home isolation and routine management of her symptoms. After her positive diagnosis, she was instructed by her primary care physician to take Aspirin 325 mg daily for prophylaxis against any potential coagulopathy. On post-operative day 10, the patient called stating she had new and increased pain and swelling of the operative upper arm and forearm. She was immediately sent for an ultrasound that showed a

an extensive deep venous thrombosis involving the subclavian, axillary, brachial, mid basilic and mid cephalic veins. Additionally there was superficial thrombus within the left proximal basilic vein to the cephalic vein. She was sent to the emergency room where computed tomography (CT) of the chest with IV contrast was obtained that showed a left lower lobe pulmonary embolus (PE) in the setting of bilateral lobe pneumonia that is also commonly seen in COVID-19 patients**. (Figure 3)** She was admitted to the intensive care unit (ICU) for respiratory monitoring and started on a heparin drip to treat her coagulopathy. During her admission, vascular surgery was consulted and recommended a venogram with possible thrombectomy. At the time of the procedure, she was found to have some residual clot in the brachial veins, but overall the course from the subclavian vein distal was widely patent, indicating success with anti-coagulation. There was also no evidence for any superimposed thoracic outlet syndrome that

could have contributed to her clot formation in the left arm. The patient remained stable and was discharged post-admission day four on Eliquis as outpatient treatment for her coagulopathy.

The patient was seen during follow-up in clinic shortly after testing negative for active infection and started formal physical therapy with gentle passive range of motion three weeks after surgery due to the delay in care from her illness. A wide range of coagulopathy labs were ordered and have been found to be negative. Her mother did have a previous history of DVT in the past. However, the patient has never had previous venous thromboembolism (VTE) events, even after prior orthopedic surgeries on her hip and knee. The patient continues to have some symptomatic sequelae from COVID-19 but is expected to have a full recovery.

DISCUSSION:

The emergence of the novel coronavirus, SARS-CoV-2, that causes COVID-19, has placed an unprecedented amount of stress and burden on our healthcare system. Early in 2020, rapid cancellation of inpatient and outpatient elective orthopedic surgery was implemented to preserve resources for hospitals. As we have slowly emerged and tried to return to a new normalcy in day-to-day orthopedic care, the long-lasting effects of the pandemic will continue to be felt.

Our case report highlights concerns we have so that we can raise awareness surrounding potential complications related to COVID-19 and elective orthopedic surgeries. Our patient was appropriately screened three days prior to her surgery with a negative SARS-CoV-2 PCR test. The sensitivity and specificity of SARS-CoV-2 PCR Testing has been reported over the last year to be 71-98% and 95%, respectively.[11, 12] Unfortunately for our patient, she had a known positive exposure at work that led to a positive and symptomatic infection three days after surgery. Routine incubation time for symptoms to emerge for COVID-19 has ranged from 2-14 days.[3] We recommend self-isolation prior to surgery for all patients, but in reality, this can be difficult to effectively implement. It's unrealistic to expect that all patients will comply with strict pre-operative isolation protocols or be able to mitigate the risk of exposure from other sources, which are simply out of their control.

To add more complexity to this case, an otherwise healthy, young patient developed a significant post-operative coagulopathy in the form of a DVT in her operative shoulder and a subsequent pulmonary embolus. This was diagnosed ten days after surgery but was likely developing from the onset of her illness. The rate of DVT and PE in routine elective arthroscopic shoulder surgery is reported to be between 0.1% to 0.3%[6,8,9] Routine post-operative anti-

coagulation has not been recommended after shoulder arthroscopy.[1] However, this highlights the other significant concern about this case, which is the rapid development of a DVT with an associated PE that could have been life-threatening to this patient.

As our healthcare system has learned more about the complications that arise from COVID-19 infections, coagulopathy is being recognized as a common finding in these patients. Large systematic reviews have analyzed the rate of VTE in COVID-19 patients with reported rates ranging from 12-17% for DVT and 8-14% for PE. [3,5,10] Surprisingly, a large majority of PE's were not associated with a DVT and it is thought the rate of undiagnosed clots s even higher than reported. Also, as expected, the rates of DVT and PE are higher in critically ill or ICU patients. [5] Although surgery is always considered a risk factor for DVT or PE, especially in lower extremity procedures, the rates of DVT or PE after arthroscopic shoulder surgery is exceedingly rare. We believe that in this circumstance, the patient experienced the perfect storm of risk factors to lead to this complication. Her undiagnosed COVID-19 infection with recent surgery placed her at increased risk to develop a DVT and subsequent PE. Our concern is that this situation may become more common even in light of negative pre-operative testing. The patient was appropriately started on anti-coagulation after her diagnosis, but whether it was too late at that point is yet to be determined. COVID-19 has been proposed to stimulate a significant inflammatory response along the endothelial lining of venous and arterial blood vessels that starts almost immediately after infection.[7] This unusual, but robust response has been found to result in high VTE rates in severely ill patients.[3,5] We still have yet to understand the effect on baseline risk for developing a DVT or PE in less severe infections. Certainly, other factors such as immobilization and deconditioning from the illness can additionally predispose patients to venous stasis and subsequent thrombosis as well. However, particular to this case, we believe

that the patients underlying COVID-19 infection helped to rapidly stimulate an otherwise rare complication in a routine, elective, outpatient surgery in an otherwise healthy, young patient.

In conclusion, this case report serves to make orthopedic surgeons aware of the possible risk factors for venous thromboembolic events associated with routine, elective arthroscopic surgeries in the setting of the COVID-19 pandemic. Even with negative pre-operative testing, patients still may be infected and become symptomatic post-operatively. Orthopes should be vigilant in their awareness of potential thromboembolic complications that may arise as a result of infection even in less serious cases of COVID-19 infections. While we can't recommend the widespread use of anti-coagulation after elective shoulder arthroscopy based on this single case report, strong consideration should be given to starting anti-coagulation in post-operative patients who develop COVID-19 acutely after their surgery.

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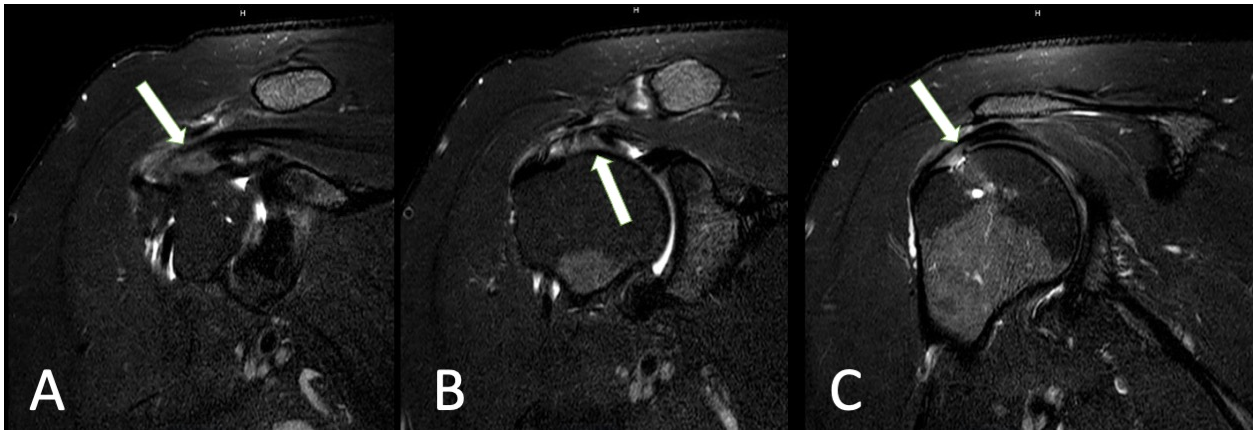
FIGURE LEGENDS:

Figure 1. Preoperative MRI of Left Shoulder. Coronal T2 weighted fat-saturated images from anterior to posterior (A, B, C) show a high grade articular-sided supraspinatus tendon tear with retraction of the torn fibers (white arrow).

Figure 2. Arthroscopy Images. A high-grade articular sided supraspinatus tear is seen from the posterior glenohumeral joint viewing portal (A). A posterior subacromial viewing portal shows the supraspinatus tendon after the tear was completed (B) and posterior (C) and lateral (D) subacromial viewing portal views showing a double row trans-osseous equivalent supraspinatus tendon repair augmented with a medial row double pulley.

Figure 3. Computed tomograpy (CT) of the chest with IV contrast shows a pulmonary embolus in the left lower lobe (red circle) with accompanying interstitial changes of the lungs associated with COVID-19 pneumonia.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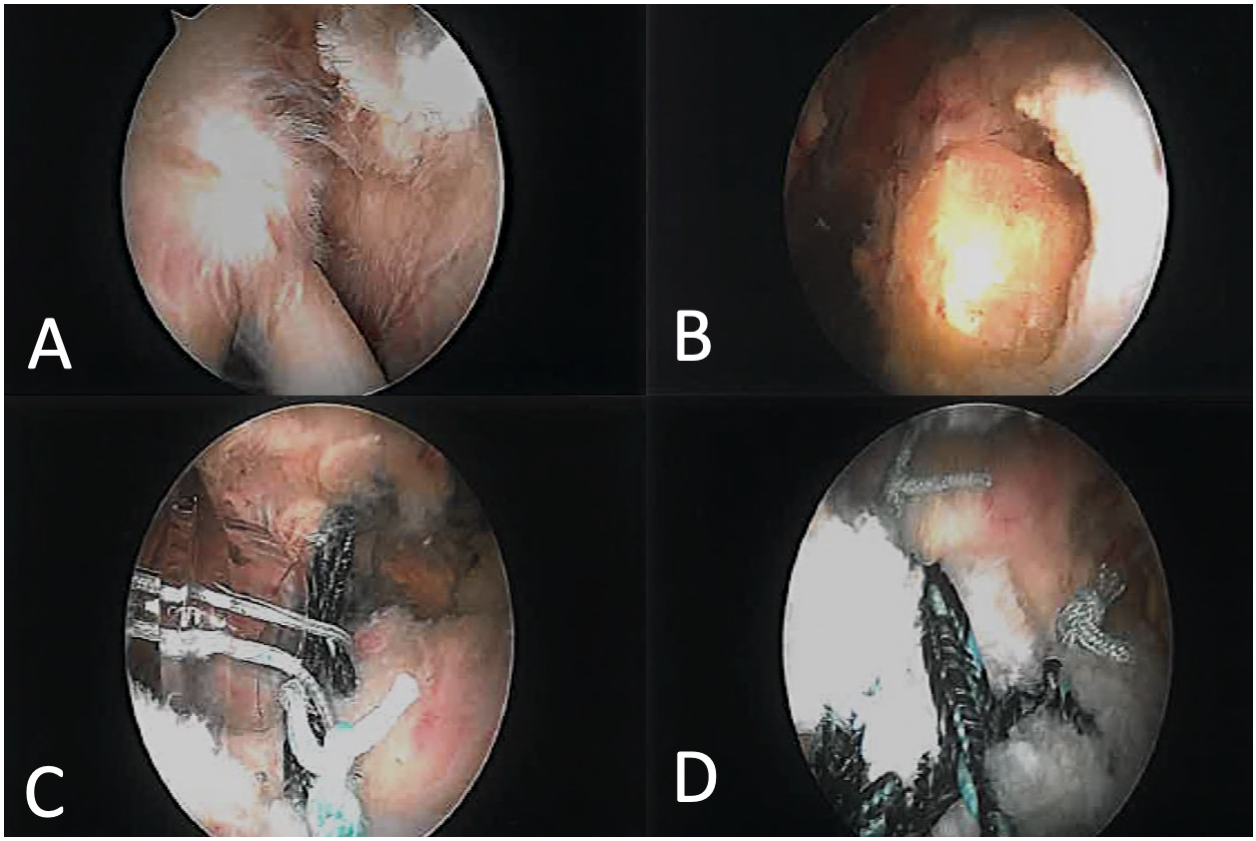
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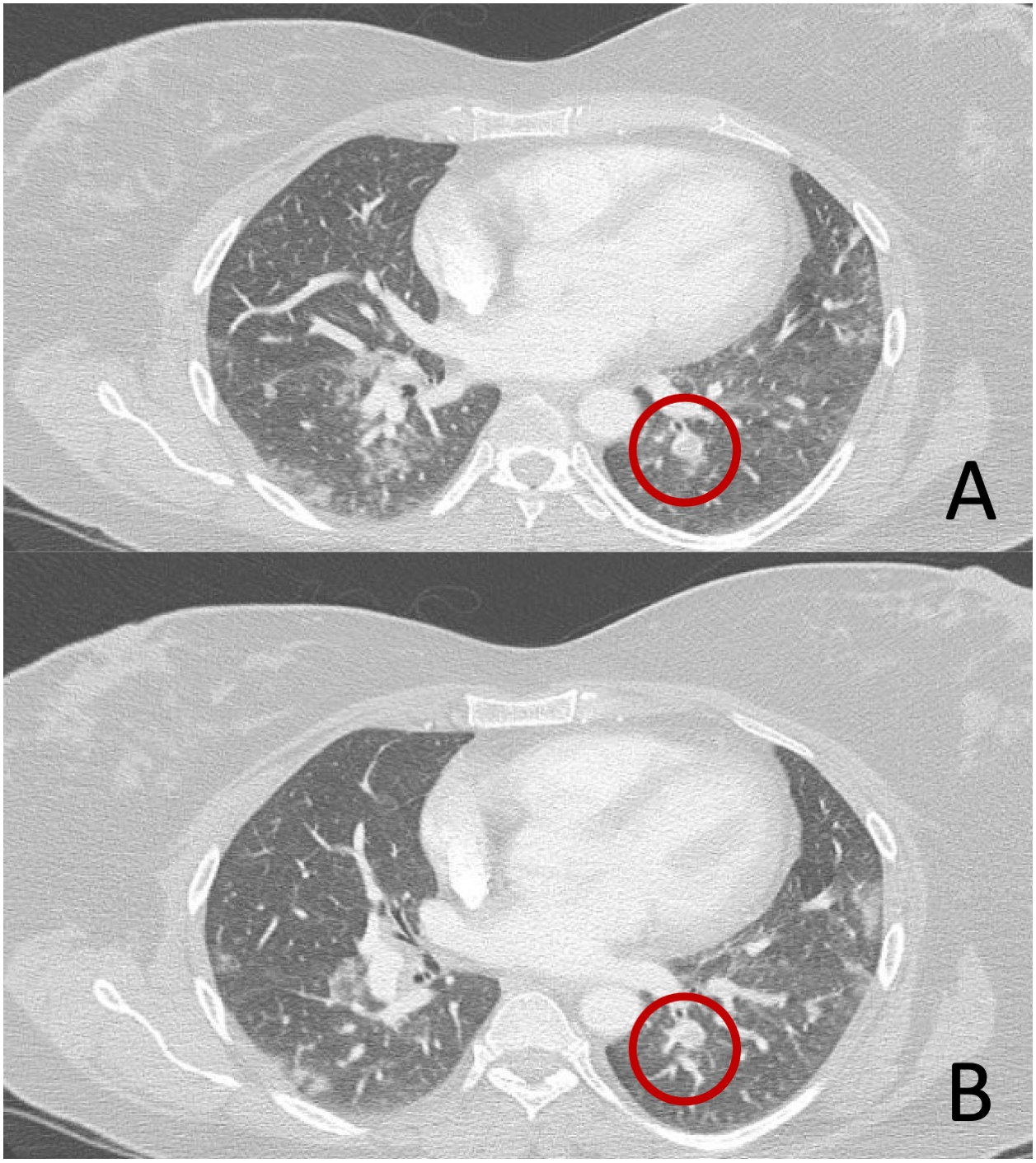
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